

Summary Research Report

SHARP Demonstration Flight: Video Broadcast System for Research in Intelligent Flight Characterization and Control

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Summary Research Report

Executive Summary: This report summarizes Santa Clara University's (SCU) involvement in the SHARP vehicle development program during the period August 1, 2000 through September 30, 2001. This work was performed as a Cooperative Agreement with NASA Ames Research Center with technical supervision being provided by the Paul Kolodziej of the NASA Ames Space Technology Division.

SHARP Program Summary - The NASA Ames Research Center (Thermal Protection Materials and Systems Branch) is investigating new ceramic materials for the thermal protection of atmospheric entry vehicles. An incremental approach to proving the capabilities of these materials calls for a lifting entry flight test of a sharp leading edge component on the proposed SHARP (Slender Hypervelocity Aerothermodynamic Research Probe) vehicle. This flight test will establish the aerothermal performance constraint under real lifting entry conditions.

NASA Ames has been developing the SHARP test flight with SSDL (responsible for the SHARP S1 vehicle avionics), Montana State University (responsible for the SHARP S1 vehicle airframe), the Wickman Spacecraft and Propulsion Company (responsible for the sounding rocket and launch operations), and with the SCU Intelligent Robotics Program.

The SCU team was added well after the rest of the development team had formed. The SCU role was to assist with the development of a real-time video broadcast system which would relay on-board flight video to a communication groundstation. The SCU team would also assist with general vehicle preparation as well as flight operations.

At the time of the submission of the original SCU proposal, a test flight in Wyoming was originally targeted for September 2000. This date was moved several times into the Fall of 2000. It was then postponed until the Spring of 2001, and later pushed into late Summer 2001. To date, the flight has still not taken place. These project delays resulted in SCU requesting several no-cost extensions to the project.

Based on the most recent conversations with the project technical lead, Paul Kolodziej, the current plan is for the overall SHARP team to assemble what exists of the vehicle, to document the system, and to 'mothball' the vehicle in anticipation of future flight and funding opportunities.

Statement of Work

The following tasks were originally proposed for accomplishment as part of this supplemental contract:

- a) Develop a video system for the S1 vehicle or sounding rocket in order to provide additional information for the evaluation of flight dynamics and characteristics.
- b) Provide real-time and/or archive-based integration of video system output with an Internet-based distribution system.
- c) Assist with the development and execution of a low-cost test and certification program for the SHARP S1 prototype vehicle. This effort will be lead by SSDL.
- d) Participate in the S1 vehicle and sounding rocket overall system integration and test in cooperation with flight team participants from NASA Ames, Montana State University and Wickman Spacecraft and Propulsion Company.

Item (a) was completed and demonstrated on several occasions in short-range functional tests. The implemented system included an on-board camera/transmitter/antenna system as well as a ground-based antenna/receiver/TV/VCR system. Two transmitters (one low power, one high power) were acquired and tested in order to perform cost/benefit analysis/testing in a hardware-in-the-loop manner [note that the low power system, while preferable from a power/mass/volume perspective, was demonstrated to be insufficient based on range].

The team surpassed the proposed goal for (a) by developing more than one ground receiving system. In fact, three such systems were developed with some variation given the team's thoughts on flight-day operational considerations. The stations had different power systems (stand-alone systems given the remote launch area: generator, battery packs, automobile battery adapters) and different antenna (ranging from a large high-gain array to a handheld antenna for possible use in the retrieval helicopter).

Item (b) was completed and demonstrated on several occasions. Several versions of the system were developed in order to compare competing technologies and their performance. Both real-time and archival distribution is available.

Item (c) was completed to the extent that the SSDL team performed vehicle assembly and test.

Item (d) was completed to the extent that the rest of the SHARP team met and communicated and performed system-level integration and test. Support of the launch did not take place due to the postponement of that event.

Personnel: SCU personnel included Prof Kitts, Mr. Pascal Stang (as an SCU research staff member – Mr. Stang started working on the project as a Stanford SSDL graduate student), and a number of undergraduate interns.

Future Work: The SCU team continues to assist the SHARP team in its current effort to assemble and document the current system. SCU is interested in continuing to assist with this project in the future.

Contact: For more information concerning the Emerald program and this research activity, contact Prof. Christopher Kitts:

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